ORIGINAL ARTICLE

ATMs and POS devices as a serious risk factor regarding human health

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ABSTRACT

Background: Using of Automated Teller Machines (ATMs) and Point of Sale (POS) devices can be one of the agents transmit various microbial and fungal infections in public. In addition because of its usage and the simplification for transporting money and the other utilizations such as providing a well accessibility to personal account for shopping and other activities which are related and required to displacing different amount of money, these devices are being preferred to use increasingly. Thus it is obvious that the severe usage of these devices by public with different level of health, can be lead to diffusion of such microbial microorganisms and play an important role in spreading a lot of illnesses, such as: skin diseases, allergies and etc. which may have many economic and health consequences to those people.

Aim: To determine the pathogens which have essential roles in imperiling the social health and recognize the factors of related contamination and illnesses, they involve thereinafter.

Study design: Descriptive cross-sectional

Methods: In this survey, a total of 6360 samples including 2610 ATMs and 3750 POS devices were randomly sampled from their keyboards and cultured on different culture medias by using principal scientific sources and standard microbial methods.

Result: The highest rate of microbial contamination from ATM devices was due to ***Staphylococcus epidermidis*** (17,36%) and its lowest rate was ***Pseudomonas Spp*** (3,22%). In case of POS devices, the highest rate was ***Staphylococcus epidermidis*** (18,53%)and the lowest rate was ***Pseudomonas*** (2,99%).

According to the results obtained in this study, the microbes which can be transmitted by ATMs and POS devices to different people, can be harmful to social health and increasing the rate of related illnesses among people; thus by right informing and warning people of bad consequences which comes afterward by disregarding and inobservance to personal and social health as well as using correct cleaning methods for these devices, can be useful for decreasing the transmission of infections properly.

Keywords: Microbial contamination, Automated Teller Machine (ATM), Point of Sale (POS)

INTRODUCTION

The Automated Teller Machines (ATMs) or Automatic Banking Machines are a typical kind of telecommunication computers which specialized for banking and financial features. These devices obtain many qualifications to client of financial institution and enable them to achieve their demands without spending a lot of time or any requirement to bank tellers or cashiers [Santiago Carbó-Valverde et al. & Jegede CA]. A typical usage of ATMs involves slotting a credit card into a recipient hole and following on screen instruction, punching the keys of the metallic keypad to enter personal pass code and commands. According to the ATM Industry Association (ATMIA), there are now close to 3.9 million ATMs installed worldwide. By considering numerous increasingly usage of ATMs and POS devices by the continuing expansion and proliferation of urban areas in all over the world and also increase of centers like banks, shopping centers, restaurants, entertaining places and etc. people generally use of these facilities for its easy accessing to their accounts by their credit cards. Although the vast majority of bacteria are harmless, a few pathogenic strains of bacteria may be causing infectious disease. Therefore, it is also expected that by the abundant use of such devices and facilities by people with different level of health, it may convert to a great source of microbial contamination, and become a transitional way to diffuse multiple various diseases and illnesses caused by bacterial and fungal microorganisms.

Rusin P et al.have cleared that many factors influence the bacteria transfers between surfaces, including: the sources and destination, surface features, involved bacterial species, moisture levels, pressure and friction between the contact surfaces and etc. The presence of viable pathogenic bacteria on inanimate objects has been reported by earlier investigators; as it has been found previously byRusin P et al., ***Salmonella spp.*** And ***E. coli*** strains can be transferred by hands to raw, processed and

cooked foods even at low levels on the fingers. In addition, Filho PPG et al. showed that snacks can easily be cross-contaminated by bacterial contamination from the hand after handling dirty currency notes.

According to the Central Bank of Islamic Republic of Iran (CBIRI), there were close to 54,300 ATMs and up to 4.2 million activated POS devices in Iran on 2019; Thus in this study in order to prevention and decreasing bad consequences, an attempt has been made to identify and estimate the amount of contamination which transfers from ATMs and POS devices.

MATERIALS AND METHODS

This descriptive cross-sectional study is about ATMs and POS devices which have been selected randomly in different areas of Tehran on 2019. A total of 6360 samples including 2610 samples from ATMs and 3750 from POS devices were studied for this research. In addition, before sampling of each devices, a consent decree had been provided and were taken from owner or responsible of such devices morally.

Sampling and Laboratory Methods: First cotton sterilized swabs were soaked by distilled water and put inside the test tubes; then the samples were taken from the ATMs monitor, metallic keypads, plastic buttons and different parts of POS devices which had been selected before. The samples were transferred to laboratory in transport culture medias as soon as possible and transferred on culture medias such as Nutrient agar, Blood agar, MacConkey agar and EMB which had been prepared before and were keeping on refrigerator.Before transfer the samples on culture medias, the prepared medias were brought out of refrigerator in order to reach room temperature. After transferring, for checking the bacterial growing, the culture medias which were passaged on were put into the incubator on 37 centigrade degrees (for 24-48 hours and more).

Isolation and Identification of Bacterial Isolates: In order to assessing the bacterial growing and colonies forming, the preserved culture medias were examined precisely by use of principals scientific sources and standard bacteriological methods such as using their colony and cellular morphology, gram staining and etc.

All the bacteria (whether Gram positive and Gram negative) could be able to grow on Nutrient agar media; also Gram positive bacteria were grown on Blood agar media and Gram negative bacteria were grown on EMB, MacConkey agar, SS agar media. For determining the specious of bacteria, these biochemical tests had been done; as mentioned below: For detecting the specious of Gram negative bacilli such as Enterobacter spp, klebsiellaspp, E.coli etc. Catalase, Oxidase, Urease test and TSI (Triple Sugar Iron Agar) (HIMEDIA, LOT00000015312) culture media were being used. For detecting the specious of Gram positive bacteria such as streptococcus spp, staphylococcus aureus and etc. Catalase, Coagulase and MSA culture media (HIMEDIA, LOT0000287212) were being used too.

RESULTS

In this study, a total of 6360 samples which comprises 2610 from ATMs and 3750 samples from POS devices were examined and assessed carefully. All the specimens which were sampled from those devices were contaminated. Also a total of 12 different bacterial isolates were obtained from ATMs and POS devices, consist of: ***Staphylococcus aureus***, ***Staphylococcusepidermidis***, ***Streptococcus spp***, ***Enterobacter spp***, ***Escherichia coli***, ***Klebsiella pneumonia, Shigelladysenteriae, Salmonella spp***, ***Pseudomonasspp***, ***Bacillus spp***, ***Lactobacillus spp*** and ***Enterococcus spp*** as demonstrated in table 1. The highest rate of microbial contamination from ATM devices was due to ***Staphylococcus epidermidis***, [453 out of 2610 (17,36%)] and its lowest rate was ***Pseudomonas spp***, [84 out of 2619 (30,22%)]. In case of POS devices, the highest rate was ***Staphylococcus epidermidis***,[695 out of 3750(18,53%)]and the lowest rate was ***Pseudomonas***, [112 out of 3750 (2,99%)] too. Also as indicated in table 1, there are no significant differences between the ATMs and POS devices in amount and percentage of each bacterial contamination isolated, actually.

Table 1: Absolute and relative frequency table of microorganisms isolated from ATMs and POS devices:

Sample items/Microorganisms	ATM	POs	Total
S.epidermidis	453(17.36%)	696(18.53%)	1148(18.05%)
S. aureus	387(14.83%)	576(15.36%)	963(15.14%)
E coli	367(14.06%)	528(14.08%)	895(14.07%)
Klebsiella spp	291(11.15%)	387(10.32%)	678(10.66%)
Bacillus spp	222(8.51%)	353(9.41%)	575(9.04%)
Streptococcus spp.	188(7.20%)	270(7.20%)	458(7.20%)
Shigella spp	162(6.21%)	229(6.11%)	391(6.15%)
Salmonella spp	133(5.09%)	118(3.15%)	251(3.95%)
Salmonella spp	133(5.09%)	118(3.15%)	251(3.95%)
Lactobacillus spp.	117(4.48%)	215(5.73%)	332(5.22%)
Enerobacter spp,	110(4.21%)	148(3.95%)	258(4.06%)
Enterococcus spp.	96(3.68%)	119(3.17%)	215(3.38%)
Pseudomonas spp.	84(3.22%)	112(2.99%)	196(3.08%)
Total	2610(100%)	3750(100%)	6360(100%)

DISCUSSION

By consideration the abundant use of ATMs and POS devices in daily life of people, absolutely it determines the consequential roll of these devices as a means to distribution various illnesses. Furthermore, since ATM and POS devices set in public, people with different levels of health accessing to them; thus the microorganisms can transfer to these devices whether by environment or the people [Onuoha SC et al. & Anibijuwon II]. In this survey, an attempt was made to define the bacterial pathogens presenting on ATM's keypads (buttons), monitors and different part of POS devices utilized in centers and stores on different areas of Tehran.

The results obtained in this study and by other investigators, revealed that there are expanded contaminations among these devices. A total of 12 different bacterial isolates were obtained from ATMs and POS devices, consist of: ***Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus spp, Enterobacter spp, Escherichia coli, Klebsiella pneumonia, Shigelladysenteriae, Salmonella spp, Pseudomonas spp, Bacillus spp, Lactobacillus spp*** and ***Enterococcus spp***. In this study, the highest rate of contamination was due to ***Staphylococcus epidermidis*** (1148 out of 6360; 18.05%),but in the same study carried out previously byOnuoha SC et al., the S. aureus was the commonest bacteria isolated (28.57%); while in our study *S. aureus* was the second commonest bacteria (963 out of 6360; 15.14%).Qualitative analysis of the bacterial isolates revealed that the abundance microorganisms of skin flora belonging to *Staphylococcus epidermidis*, *S. aureus*, *E.coli*, *Streptococcus spp*, *Pseudomonas spp* and *Enterobacter spp*.***Staphylococcus epidermidis*** is a coagulase-negative species we have found and a commensal of the skin, but can cause severe infections in immuno-suppressed patients and also responsible for endocarditis. The rate of other bacteria represented on above study are almost similar to our results.

Tekerekoğlu MS et al. collected a total of 100 specimens from keypads and screens of many ATM devices, were assessed for microbial accumulation. All the specimens were positive for bacteria accumulation too. In this research ***bacillus ssp***. has been observed in all specimens and also it was the most bacteria found. The authors understood a typical similarity among the bacteria accumulated on mobile phones, computers and ATMs according to their resembling physical and operational aspects. In comparison with our study we have found more different isolated bacteria; however it can be a corroborated to our results.

A similar study was carried out byAnibijuwon IIet al. in Ilorin Metropolis, comparing the bacterial isolates in the morning and afternoon. In above study, they found similar isolated bacteria in comparing with us, but we have found more different isolated bacteria with different percentage. In above study the highest rate was due to *Enterobacter aerogenes*(39.32%), following by *S. aureus* (33.76%),*E. coli* (33.19%) and *klebsiellassp.* (30.34%). *Enterobacter aerogenes*, *E. coli and klebsiellaspp*are the enteric bacteriae and live in the animals and humans intestinal tract, also improper hand washing could be adduced to why enteric organisms were isolated from ATM machines.

Okoro et al. have studied ATMs machine for assessing pathogenic bacterial contamination which a total of 200 samples were obtained from 7 different locations in Kaduna Metropolis. In this research the bacteria found are the same as our study but with different percentage. The highest rate of contamination was related to ***Klebsiella pneumonia*** (46 out of 200 samples, 23.00%) while it is the fourth commonest bacteria found in our study (678 out of 6360 samples, 10.66%). ***Shigelladysenteriae*** (37 out of 200 samples, 18.50%), ***S. aureus*** (33, 16.50%), ***Salmonella typhimurium*** (32, 16.00%) and ***Pseudomonas aeruginosa*** (29, 14.50%) were the other bacteria found. In above study ***E.coli*** had the smallest percentage of isolates (with 22 out of 200 samples, 11.00%) while it's the third commonest bacteria found in our research (with 895 samples out of 6360, 14.07%). Probably, these variations might occurred through disregarding to personal and social hygiene or the difference between the health's levels of people using ATMs in each research.

Another research performed in India on 2013, is about enumeration and characterization of coliforms harbor on ATMs keypads and it buttons. Saroja V et al. have found almost the same bacteria isolated in our study, like *E.coli*, *Klebsiellaspp*, *Shigellaspp* and etc. ***Shigella*** can even survive in dust particles for six weeks in room temperature, so it can transmission to the surface of ATMs and POS devices by improper disinfected hand and natural phenomenon like wind and rain when they located in the open areas.

Also, a virtual collation is done between the results of our research and those which have studied onmicrobial contamination of similar devices such as mobile cell phones and computers which generally have the same framework and performance as ATM and POS devices have [Matini E et al. &Press M&Ulger F et al. & Anastasiades P et al. andAnderson Get al.].In all these studies almost all the specimens were highly contaminated commonly by *S. aureus*, *S. epidermidis*, *E. coli*, *Klebsiellaspp*, although some specious of *Proteus*, *Actinomyces*, *Citrobacter* and *Acinetobacter spp* have detected too. So by take a close look to the results, it can conclude that ATM and POS devices has lesser and limited bacterial contamination in contrast to mobiles or computers set.

In comparison with previous studies, our study population was the largest sample and this was the main strength of our study. Therefore, by the numerous numbers of samples taken, its precision, accuracy and reliability would be also higher. So, by respect to this results, many pathogenic microorganisms are harbored in these devices and can cause bacterial infectious disease such as: various skin complications, inflammatory reactions, contaminated ulcers and also the transmission of different septic illnesses among the people. So by considering the roll of ATMs and POS devices in hazarding the public health, use of various sanitizing methods, such as periodical and regular use of ultraviolet light irradiation for a certain times a day [Fatehi S et al.], cleaning the monitors and keypads of devices with

antiseptic materials or alcohol in a regular basis are recommended.

CONCLUSION

The purpose of this study was to assess the amount of ATMs and POS devices contamination. Now by regarding to the results obtained in this study, it can be conclude that such devices are essentially a main source of bacterial contamination and also be a transmittal way to publish many various disease and complications by different microorganisms exist on them. So by the means of proper disinfection and correct sanitizing in a regular basis, we can decrease amount of contamination and illnesses followed subsequently.

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